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Leverage points for climate change mitigation at tourism destinations: A holistic interdisciplinary approach

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HIGHLIGHTS

- Identifies leverage points for climate action in small-scale tourism destinations through an interdisciplinary study.
- LCA in visitor facilities identifies key infrequent decision point.
- Nudge + can increase sustainable choices without reducing visitor satisfaction.
- Combines shallow operational changes with deeper mindset interventions.
- Proposes integrated, governance-supported pathways to low-carbon tourism.

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ABSTRACT

This study examines strategic leverage points for climate change mitigation in small-scale tourism destinations, using an interdisciplinary approach that combines life cycle assessment (LCA) and behavioural experimentation. The purpose was to identify operational and behavioural interventions that can reduce greenhouse gas emissions while maintaining visitor satisfaction. The LCA, conducted at an animal park, revealed that heating systems in visitor facilities, particularly during off-peak seasons, represent critical infrequent decision points for emissions reduction. Although large-scale infrastructural changes, such as the adoption of renewable energy, may be beyond the reach of small businesses, targeted efficiency improvements and seasonally optimized operations can deliver meaningful climate benefits. On the demand side, a lab experiment tested a *nudge* + approach that combined subtle choice architecture with reflective, values-based communication. Results suggested that nudge + interventions increased the likelihood of visitors making more sustainable choices without diminishing the quality of the tourism experience. These findings suggest that combining shallow leverage points (e.g., operational efficiency, behavioural nudges) with deeper interventions (e.g., reframing goals, fostering sustainability-oriented mindsets) offers the greatest potential for contributing to a larger systemic change. For small-scale tourism destinations, integrating bottom-up innovation with supportive governance and strategic communication can provide scalable, context-sensitive pathways towards low-carbon futures.

1. Introduction

Climate change has become one of the key global challenges of our times, while the tourism sector has emerged as both a significant contributor to greenhouse gas emissions (GHG), as well as a victim of their adverse effects (e.g. Ghosh et al., 2024; Gössling et al., 2023; Chen et al., 2017; IPCC, 2023; Scott and Gössling, 2022). Tourism impacts climate change in several ways, mainly through the considerable GHG emissions from transportation to/from and within tourism destinations (Lenzen et al., 2018). The tourism sector has been repeatedly accused of

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unwillingness to change practices despite the urgency of the matter (Gössling et al., 2024; Loehr and Becken, 2021), thus indicating a need for more research on strategies and opportunities for climate change mitigation.

Tourism's contribution to climate change, however, extends beyond transportation. It includes the emissions from the operation and maintenance of accommodation and related infrastructure, as the energy used for heating, cooling, and waste management can produce a significant amount of GHGs (26 % of the tourism-related emissions (Gössling et al., 2023). Other tourism-related processes, such as food production, storing, and transportation, water pumping and treatment, land use change and deforestation associated with construction, to name a few, – all may also lead to significant carbon footprint (Dhir et al., 2020; Gössling et al., 2023; Poore and Nemecek, 2018).

While curbing aviation emissions require systemic change currently out of reach (Gössling et al., 2024) mitigating other tourism-related climate impacts is more feasible for small-scale entrepreneurs here and now. Small-scale destinations are particularly exposed to climate variability and energy dependence, yet they also possess considerable potential for innovation through localized, bottom-up mitigation actions. Studying small-scale destinations is relevant for two reasons: tourism is a sector dominated by small and medium sized entrepreneurs, and second, environmental impacts of tourism, including carbon emissions, tend to be of cumulative nature (i.e. resulting from individually minor but collectively significant actions over time) (Yachin, 2020; Margaryan and Stensland, 2017). Despite growing policy attention to sustainability transitions, research on concrete opportunities for climate change mitigation in tourism systems remains limited, as interdisciplinary studies that integrate environmental accounting and behavioural change at the destination level are scarce.

To address this gap, in this study we explore how small-scale tourism destinations can identify and activate effective points of intervention for reducing their climate footprint, with a particular focus on energy-related emissions that represent the dominant and most tractable component of their environmental impact. Building on Donella Meadows' (1999) seminal framework *Leverage Points: Places to Intervene in a System*, we conceptualize tourism destinations as socio-ecological systems, where targeted interventions, whether technological, managerial, or behavioural, can trigger broader systemic change. Briefly stated, these leverage points can be described as "places in complex systems where a small shift may lead to fundamental changes in the system as a whole" (Abson et al., 2017, p. 30, see also Meadows, 1999). Similar ideas of favourable moments for introducing change have also appeared in other fields as teachable moments (*kairos*), critical junctures, moments of 'unfreezing', windows of opportunity, or tipping points (Lawson and Flocke, 2009; Capoccia and Kelemen, 2007; Gladwell, 2006; Hunter, 2024). In the context of climate mitigation, leverage points range from shallow efficiency improvements to deep shifts in values, goals, and paradigms that underpin tourism development (Abson et al., 2017; Fischer and Riechers, 2019; Chan et al., 2020; Loehr and Becken, 2021).

The aim of this paper is to explore strategies with leverage points (Abson et al., 2017; Riechers et al., 2021) for climate change mitigation, focusing on the obstacles and opportunities faced by small-scale tourism destinations and businesses. We achieve this by examining two complementary strategies situated at different levels of this leverage-point spectrum. The first, ecological modernisation, represents a technological and managerial approach aimed at enhancing environmental performance through energy efficiency, renewable transitions, and innovation within existing market structures (Jänicke, 2020). The second, behavioural change, focuses on influencing consumer choices and social norms through non-coercive interventions such as nudging and its more reflective extension, *nudge* + (Banerjee et al., 2022). Together, these strategies connect operational and experiential dimensions of tourism, highlighting how both producers and consumers can contribute to climate change mitigation without compromising the hedonic value of the tourist experience.

In our novel approach, we examine opportunities for climate-friendly advancements from both the business (supply) and the consumer (demand) perspectives, conducting these investigations simultaneously throughout the research project. This is achieved through combining methods rarely applied in tourism studies, namely life cycle assessment (LCA) and a laboratory experiment at a social science simulation lab.

The case study involves an animal conservation center and a zoo, Vildriket, located in the rural community of Järvsö in the Gävleborg province of Sweden. Vildriket, in addition to being a conservation-oriented enterprise, represents a typical structure of a small-scale tourist destination, encompassing a core attraction, a visitor center, accommodation, catering, shopping, and conference facilities on its premises. This allows for transferability of the results of this study to other tourism contexts.

2. Leverage points for climate change mitigation

To structure and prioritise climate change mitigation actions for small-scale tourism destinations, we draw on Meadows' (1999) framework of leverage points, which are defined as specific places in a complex system, where small, well-focused interventions can produce significant, long-term change. Meadows (1999) suggest 12 leverage points ranging from shallow to deep, with changing parameters (e.g., efficiency measures) at the shallow end, through altering information flows and feedback loops in the mid-range, to changing system goals and paradigms at the deep end. The deepest leverage point of paradigmatic shifts involves stepping outside dominant worldviews to adapt to multiple perspectives. Riechers et al. (2021, pp. 205–206) maintain that most interventions tend to be "highly tangible but essentially shallow leverage points" (i.e., using interventions that are easy but have limited potential for transformative change) whereas "given the pressing challenges the world is facing, we see an urgent need to focus on less obvious but potentially more effective interventions".

This framework has been widely adopted, further tested, and refined within sustainability scholarship, including writings on climate change and tourism (see e.g. Abson et al., 2017; Chan et al., 2020; Fischer and Riechers, 2019; Loehr and Becken, 2021; Rosengren et al., 2020). Loehr and Becken (2021), for example, apply this framework to interventions that could reduce climate change risk at destinations and identify seven leverage points for the case of Vanuatu. We consider this approach particularly relevant for climate change mitigation in tourism destinations as it helps researchers and practitioners test which interventions might have the most transformative potential, highlighting shallow and deep leverage points to drive systemic change. Furthermore, this approach frames tourism is a socio-ecological system, where changes in management, values, and feedbacks can have cascading impacts on systemic climate change mitigation efforts.

The aim of climate change mitigation is to implement strategies that reduce the magnitude of climate change. Climate change mitigation efforts can make a difference, as has been projected by multiple climate models and scenarios (e.g., Chen et al., 2017). Several climate change mitigation approaches exist, including transition to renewable energy sources, increasing energy efficiency, carbon trade, carbon offsetting through afforestation and reforestation, waste management to name a few (Chen et al., 2017). Below we discuss ecological modernisation and behaviour change as two commonly applied approaches to foster climate change mitigation in tourism. Importantly, we focus on the bottom-up initiatives that could be implemented at specific leverage points without compromising the hedonic value of tourist experience (Dolnicar, 2020).

2.1. Climate change mitigation through ecological modernisation

Ecological modernisation is a well-established sustainability strategy, which aims to improve environmental performance through resource-efficient innovation. Originating in the 1980s in Germany and reinforced by the sustainable development agenda of the 1990s, the concept of ecological modernisation spread internationally. Ecological modernisation has achieved considerable success, for example, in implementing renewable energy transitions, waste recycling, and efficient water supply (Jänicke, 2020). Essentially, ecological modernisation is aimed at opening a new development direction, which would shift away from top-down measures of controlling unsustainable production processes, towards emphasizing introduction of new resource-efficient and knowledge-intensive technologies (Jänicke, 2008, 2020; Lidskog and Elander, 2012).

The popularity of the ecological modernisation approach can be explained not only by its congruence with market-based mechanisms but also due to the co-benefits that emerge from green innovations. For example, climate change mitigation efforts would be co-beneficial with many other fields. These can include environmental (e.g. air quality, health, agriculture, biodiversity), energy (alternative sources, energy efficiency) or economic factors (e.g. long-term economic sustainability, competitiveness, employment) (Jänicke, 2020). In fact, in case of climate change mitigation, the co-benefits have a particularly strong 'no regrets' argument, ironically summarized in a viral cartoon by Joel Pett: "*What if it's a big hoax and we create a better world for nothing?*" (USA Today, 2009).

Climate change mitigation efforts in tourism can occur and be accounted for on various levels – from global, national, subnational (cities, communities, destinations) to the micro level of individual firms. Accounting for emissions and their mitigation in the largest emissions subsectors (i.e. transportation (aviation, land- and water transport), food and accommodation) remains a major challenge. Life Cycle Assessment (LCA) is commonly applied to understand climate impacts in business or product-related contexts (Frischknecht et al., 2007; Filimonau, 2016; Herrero et al., 2022). LCA has become quite a popular environmental accounting tool, as it supports the principles of ecological modernisation by assessing impacts of various technologies throughout their life cycles, thus having an overall emphasis on technological innovation as a pathway to sustainability. In other words, LCA can validate environmental claims of new technologies, making the benefits of modernisation quantifiable and actionable. Nevertheless, LCA has only rarely been applied in tourism (e.g., only seven tourism studies were identified by Gössling et al. (2023).

By applying LCA, the tourism sector can identify significant environmental impacts, compare alternatives, and implement more sustainable practices across all aspects of tourism operations (De Camillis et al., 2010; Filimonau, 2016; Herrero et al., 2022). In this study, we used the LCA approach to understand challenges of a small-scale tourist destination, which contains all the typical tourism subsectors (accommodation, food services, conference venues, activities) in order to contribute to better understanding of the most appropriate leverage points and the overall efforts to mitigate tourism impacts on climate.

2.2. Climate change mitigation through behavioural change

The behavioural change approach involves 'soft policy' plus theories and procedures used to influence individual or group behaviour in order to achieve specific outcomes (Higham et al., 2016; Filimonau et al., 2017; Lehner et al., 2016; Nowak, 2025). Soft policy refers to non-coercive, voluntary measures used by governments, organisations, or authorities to influence behaviour without imposing strict legal obligations (i.e. hard policy). These policies are of indicative rather than regulatory nature, since they rely on encouragement, recommendations, or incentives rather than direct regulation or penalties. In tourism, behavioural change efforts can aim at reducing negative impacts by, for instance, cutting on long-haul holidays, opting for eco-friendly transport, supporting responsible providers, along with making sustainable consumption choices (Juvan and Dolnicar, 2017; Viglia and Dolnicar, 2020; Nowak et al., 2023; Reisch et al., 2021).

One popular tool of behavioural change interventions, which has been adopted by the tourism sector, is *nudging*. Popularized through Richard Thaler and Cass Sunstein's book *Nudge: Improving Decisions About Health, Wealth, and Happiness* (Thaler and Sunstein, 2008), nudges are designed to influence decisions by making desirable choices easier, more convenient and attractive while not restricting freedom of choice. The effectiveness of nudges is empirically supported even though their long-term effect is debated (e.g. Banerjee et al., 2022; Nowak, 2025; Higham et al., 2016; Filimonau et al., 2017; Lehner et al., 2016).

There are different kind of nudges, fine-tuned to a wide range of contexts. Carlsson et al. (2021) for example differentiate between cognitive green nudges, which attempt to make green choices easy (e.g. highlighting vegetarian options in menus; placing eco-friendly options as defaults) and moral green nudges, which capitalize on social norms and positive self-image (e.g. reusing hotel towels or buying eco-labelled products) (Nowak, 2025; Nowak et al., 2023; Schubert, 2017; Souza--Neto et al., 2023). Other researchers also differentiate between *'think'*, '*boost'* and more recent *nudge* + frameworks to nudges (Banerjee et al., 2022). Nudge + can be conceptualized as an upgraded version of nudge, which makes the nudge transparent to the public (thus avoiding the ethical dilemma of hidden manipulation) and tries to encourage conscious reflection (Banerjee et al., 2022). In their study on promoting climate citizenship, Banerjee et al. (2022) compared these various nudge frameworks and suggested that nudge+ is a promising way to introduce simple modifications to traditional nudges, ensuring that autonomy and reflexivity are maintained, leading to lasting changes, all of which serves as a point of departure for this study.

To summarize, in this article we approach climate change mitigation in tourism by exploring two key bottom-up sustainability strategies: ecological modernisation, meaning the potential for implementing mitigation efforts within business operations and climate change mitigation through facilitating consumer behaviour change. These leverage climate change mitigation points are identified through interdisciplinary analysis, including Life Cycle Assessment (LCA) and behavioural insights (through testing nudge and nudge + interventions in a social science lab) tested for a small-scale destination. In practical terms, we identified leverage points by tracing where decisions or behaviours in the tourism system have strongest potential to influence climate footprint or to trigger wider behavioural or organisational feedbacks. Following Meadows (1999) and Abson et al. (2017), a leverage point is defined not by its location but by its function within system dynamics, i.e., a node where a relatively small, well-targeted change can shift flows of energy, information, or meaning throughout the system.

3. Context description

Järvsö, a small community in Gävleborg county of Sweden, is home to around 4600 people. Situated 320 km north of Stockholm, Järvsö is conveniently reachable within approximately 3 h by train or car/bus from Stockholm or Arlanda International Airport. Ski tourism plays a crucial role in Järvsö's economy. For ski destinations like Järvsö, the issue of climate change is particularly pressing and is a top priority in their sustainability efforts. In 2021 Järvsö became the first Swedish destination to receive sustainability certification from UN's Global Sustainable Tourism Council (GSTC). Additionally, Järvsö hosts an annual Sustainability Summit, where local and global sustainability issues are discussed. This demonstrates already existing efforts and commitment necessary for climate action at the destination.

Vildriket zoo and conservation centre, chosen for this case study, is one of the key attractions in Järvsö, hosting more than 20 Nordic fauna species. Despite its small size, Vildriket represents a typical tourist destination, encompassing the standard array of tourist facilities on its premises, such as a core attraction, a visitor centre, a conference center, a hotel, a restaurant, a café, and a shop. At the same time, due to its planning, the sustainability-related choices faced by tourists and their behaviour options at the zoo were limited and therefore rather easy to simulate in a lab environment, which gave us the advantage to adopt an experimental approach. Essentially, Vildriket served as a model destination with several typical characteristics, which makes our findings relevant to other destinations and contexts.

4. Methods, analysis and results

Although tourism is a highly interdisciplinary field, truly interdisciplinary research, bringing together methods from natural and social sciences, in tourism remains exceedingly rare. In this study we combine LCA with a laboratory experiment and synthesize the results in order to provide new insights regarding climate change mitigation opportunities at small-scale tourist destinations.

4.1. Life cycle assessment (LCA) of tourist destination facilities

In this segment of our case study, we focused on identifying leverage points for "infrequent decisions" made by businesses through Life Cycle Assessment (LCA). These are rare but significant choices, such as altering their supply chain or investing in energy-efficient appliances, aimed at reducing emissions. Although these decisions might initially demand more resources, expertise, and financial investment, they have the potential to significantly lower emissions and eventually lead to cost savings in the long term. We aimed to assess the climate impact of a visitor-oriented business and identify key areas where climate mitigation efforts can be most effective.

Life Cycle Assessment (LCA) methodology employed for this study followed the International Organisation for Standardisation (ISO) 14040 standards, which primarily consists of a) goal and scope of study; b) life cycle inventory of the system studied; c) impact assessment of the study; and d) the interpretation of results. In order to perform the LCA, Simapro v.9.4 with Ecoinvent 3.4 have been used.

Data collection was carried out in partnership with the Vildriket's management team. Initially, the entire zoo, including all its components, was systematically mapped. To comprehensively understand the zoo's operations during a typical day, a series of detailed walkthrough surveys of all zoo facilities were conducted. Additionally, the zoo management shared information regarding their energy consumption and visitor numbers from 2018 to 2021 (see Fig. 1). Our primary objective, however, was to evaluate the climate efficiency of the tourist-oriented services, including facilities like the visitor centre, hotel, restaurants, cafes. It is, therefore, important to note that the LCA was limited to the visitor services of the zoo and omitted the systems in place for animal care.

A quick initial overview of the zoo operations revealed quite efficient material use and waste management systems. This preliminary observation also highlighted that the zoo uses a significant amount of electrical equipment. Consequently, the environmental impact of the zoo's visitor services was primarily due to energy spent on heat. Since the zoo receives its electricity from external sources, the LCA did not examine the environmental performance of electricity provision. Instead, the focus was on the usage of electricity at the zoo. Thus, the primary aspect evaluated was the cumulative energy demand. In order to evaluate the cumulative energy demand of the system, an energy analysis was conducted following standards of the Cumulative Energy Demand (v1.09) impact assessment method. Additionally, the overall climate impacts were evaluated in line with the standards in Annex II of the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5), which are specifically designed for assessing climate impacts. Consequently, the primary functional unit used in this analysis was *per month of service to visitors*.

Energy consumption in the hotel rooms was estimated by calculating the potential energy consumed if the service is fully provided and the proportion to which the room accommodates tourists in that month. For example, a room may serve 2 guests per night and over 30 days has potential to serve 60 guest-nights. However, as the room sometimes is not occupied, or sometimes only occupied by 1 person, the guest-nights is estimated based on the occupancy data and combined with estimated electric appliance use. Other common areas throughout the zoo were found to be all operating everyday throughout the year.

4.2. Results

The zoo employs a series of processes to accommodate, educate, and service tourists. Based on the energy consumption and visitor counts provided by the zoo, we identified that energy consumption can be as high as 35 000 kwh per month, while visitors can peak at 40 000 individuals. However, as shown in Fig. 1 the number of annual visitors and annual energy consumption do not align. A further investigation into the seasonal variation for consuming electricity from 2018 to 2021 reveals that only during summer electricity consumption significantly correlated with the visitor numbers. This pattern did not change between the periods before and after the COVID19 pandemic (see Fig. 1).

The energy consumption measured was for the entire zoo, rather than the visitor service system on its own. During the walkthrough of the zoo operations, it was found that the system serving the animals consumed the same amount of energy throughout the year. Although the animal-serving system was excluded from this study, it can be assumed that its contribution to the overall electricity demand by the zoo (as reported in Figs. 1 and 2) does not reflect the relationship between electricity consumption and the number of individuals.

Further investigation of the cumulative energy demand suggests that the main processes within the visitor service system of the zoo that holds similar annual energy consumption trend as that in Fig. 1 (in the order from most pronounced to least pronounced) are: the exhibition, the visitor centre, the hotel, and the restaurant. The main contribution to these processes came primarily from heating appliances. We identified that heating units in common areas of the hotel, toilets, visitor centre, and the exhibition were operating at high capacity throughout the fall, winter, and spring regardless of visitor quantity (see Fig. 2). Based on this finding the heating units seem to be responsible for main energy consumption in the zoo. Heating the visitor service system potentially accounts for 50 % of the overall electricity use during winter. In summer the share of heating devices in the overall electricity demand drops to approximately 10 %.

The overall potential climate impact and cumulative energy demand from the visitor service system was determined to be approximately 2-ton CO_{2eq} per month and 450 GJ per month respectively. Following the study on CO_2 uptake of temperate forest revealing a potential approximate CO_2 uptake of 100 ton CO_2 per km^2 and month during summer months (based on measured 100 g CO_2/m^2/month during June to October), the influence of the conservation system and the forested area in the zoo would provide a better insight into the nature of climate impacts of the zoo, and to see the overall potential for carbon neutrality and possibilities for carbon storage. However, whether the climate impact is lessened by the forest kept at the zoo and the associated conservation system must be subjected to further investigation.

4.3. Facilitating behavioural change: testing a nudging approach

In this segment of the case study our objective was to identify leverage points for "frequent decisions" through the analysis of the customer journey at the destination as well as subsequently test choice architecture strategies. Specifically, we were interested in how nudging and nudge + approaches could minimize the visitors' climate footprint at the destination and foster a shift towards more environmentally friendly behaviours and attitudes. To achieve this, we conducted a laboratory experiment complemented with questionnaires. Laboratory experiments offer the advantage of a controlled environment and the ability to gather detailed information about participants.

The experiment was conducted in the social science laboratory (at Mid Sweden University). This facility, a 64-square-meter room, is

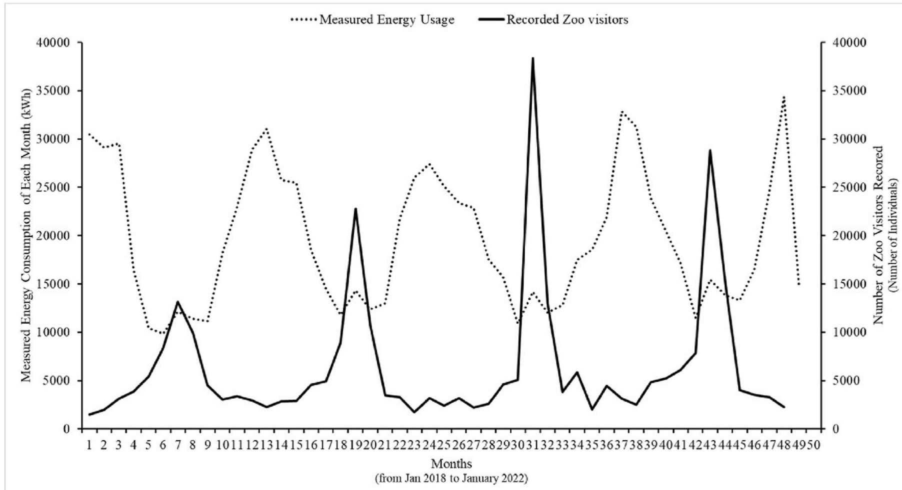

Fig. 1. Overall energy consumption and overall population of visitors recorded each month between 2018 and 2021.

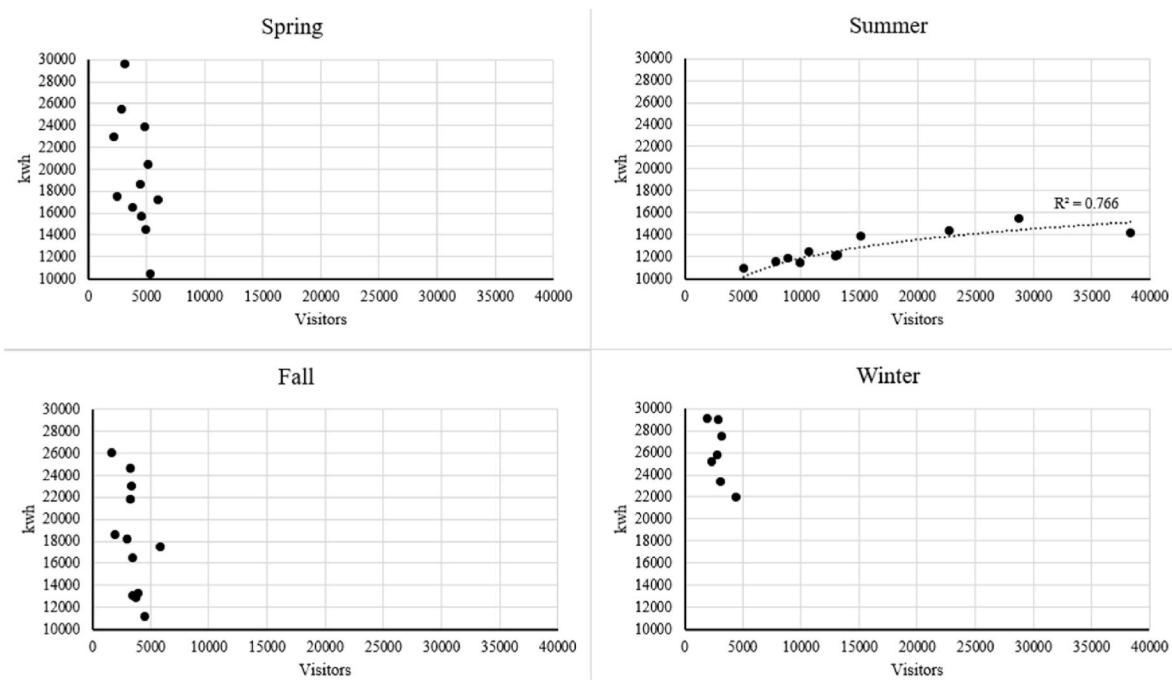

Fig. 2. Relationship between number of visitors and the overall energy consumption of the whole zoo at different seasons.

equipped for creating immersive 360-degree simulations with audio, visual, olfactory and vibration effects. For our study, we simulated a visit to Vildriket using videos, sounds, and images recorded at the animal park, along with original materials from Vildriket, including the restaurant's menu, signage, photographs, and website excerpts.

We invited volunteers to participate in our experiment by offering them the chance to experience nature in a laboratory setting, with a lunch coupon as a reward. Eligible participants were required to be over 18 years old and understand Swedish. The invitation was circulated around the university campus, and posters were put up at key public spaces in the city, e.g. on the announcement boards at the train station, museums, and libraries. In order to ensure randomisation, all participants had to register online and fill out a questionnaire prior to participating, where they answered questions on environmental attitudes and behaviours, diet as well as demographics. No statistically significant difference was found between groups on all of those parameters.

The experiment was conducted over three days in October 2022, following a pilot experiment with 7 volunteers. Our experiment was divided into three distinct approaches, and we named the treatment groups as follows: *Control*, with no manipulations; *Nudge*, designed to influence specific behaviour through subtle changes in the choice architecture; and *Nudge+*, which expanded on the nudge approach by adding elements to the customer experience to promote self-reflection (Banerjee et al., 2022). We carried out nine sessions in total, with one session per day for each of the three treatments. Group sizes varied from seven to twelve participants per session, and each participant was exposed to only one treatment. All in all, 91 individuals took part in the laboratory simulation (Control N = 27, Nudge N = 30, and Nudge + N = 34).

The study followed the guidelines of Swedish Ethical Review Authority (*Etikprövningsmyndigheten*) and GDPR. Furthermore, we consulted a member of this Authority who was in the study's reference group. Participation was voluntary and involved no risk of harm to the participants. All the participants were above 18 years old and underwent a three-step procedure of documenting their informed consent according to the Authority guidelines.

4.4. Experiment description

The simulation commenced at the reception of Vildriket, where a member of the research team, playing the role of an employee, greeted the participants. They then proceeded to 'visit' various animal enclosures – those for muskox, moose, wolf, and reindeer. In each enclosure, a 360-degree video showcasing the animals was projected onto the walls of the laboratory, while a large digital signboard in a corner of the room provided information about the animals on display. To mimic the actual layout of the animal park, the simulation included videos of walking along a forest-like trail between the enclosures. Different messages were displayed on the signboard at various points along the trail. About three-quarters into the visit, participants reached the restaurant where they made a food choice from a menu. The entire simulated visit lasted for 16 min and included a welcome speech, six distinct customer journey segments (each a 360-degree simulation of a specific location in Vildriket), six trail sections, five signboard messages, and one decision-making scenario (see Fig. 3).

The critical decision-making point of our experiment occurred during the restaurant segment, where the primary variable under study was the participants' menu selections. Our study's focus was not directly on food choices, but rather on food choices as a suitable proxy of pro-environmental behaviour within this specific research context (albeit sustainable food itself is an important tool for climate change mitigation (see e.g. Filimonau et al., 2017; Reisch et al., 2021; Nowak, 2025). The choice of food was particularly relevant in our study because the restaurant represents the primary setting in Vildriket where visitors encounter a clear decision-making situation where they can choose between more sustainable or less sustainable options.

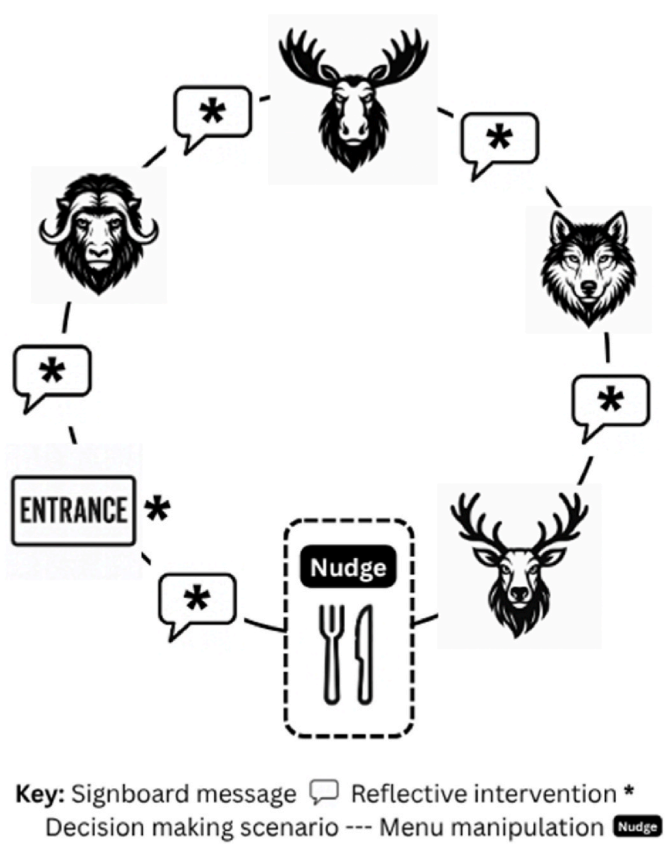

Fig. 3. Schematic representation of the experiment process.

In our experiment, we utilized the actual menu from Vildriket's restaurant. This menu featured three meat-based options (a hotdog, a cheeseburger, and a kid's burger) and two plant-based ones (a plant-protein hot dog and a burger). We maintained the original menu's graphics and pricing across all three experimental treatments. The *Control* group received the standard menu and saw neutral information about animals on the signboards. For the *Nudge* and *Nudge* + treatments, we redesigned the menu based on insights from prior research (Banerjee and John, 2021; Banerjee et al., 2022; Viglia and Dolnicar, 2020). We altered the menu by rearranging the order of the dishes, placing the vegan options on top. We also added red-yellow-green labels to show the climate impact of each dish and included a motivational message about positive impacts of one's food choices. The *Nudge* + treatment group also received an altered welcome speech where they were informed about the zoo's environmental efforts, as well as being exposed to altered signboard messages focusing more on sustainability messages based on the information from WWF Sweden and UNDP Sweden.

4.5. Results

The average age of the participants was 36, with females comprising nearly two-thirds (64 %) of the group. The majority, 76 %, had higher education. Interestingly, 15.4 % of the participants adhered to vegan or vegetarian diets, a higher proportion than Sweden's general population rate of 6.5 % - this group was excluded from further analysis. On average, these participants had visited zoos 1.4 times in the last five years and held neutral views about zoos. Regarding the experiment itself, feedback indicated that participants found it engaging and straightforward, felt comfortable and secure the whole time, and did not perceive it to be too long.

In our experiment, the key variable we focused on was the food choices made by participants. Since we excluded the vegan/vegetarians, our effective sample size was reduced to 77 participants (Control N = 21, Nudge N = 26, and Nudge + N = 30). For analytical purposes, we categorized the five menu dishes into two groups: Meat and Plant-based.

Across all three experimental conditions, a significant proportion of participants chose plant-based options: 33 % in the Control group, 42 % in the Nudge group, and 57 % in the Nudge + group. When we statistically analysed the relationship between the treatment and the food choices (meat or plant-based), the results indicated no significant association overall $p < .05$ level (X^2 (2) = 4.0, N = 77). However, considering the small sample size and the presence of a significant linear-by-linear association and adjusted residuals, we conducted further post-hoc analysis (type 1 error controlled). This additional analysis, using Pearson's chi-square test, revealed a statistically significant difference in food choices between the Control and Nudge + groups (X^2 (1) = 3.84, $p \leq .05$, N = 51, V = 0.275, indicating a small to moderate effect size). Specifically, participants in the Nudge + group were significantly more likely to choose plant-based dishes compared to those in the Control group. It's important to note that this significant effect was only observable when comparing the Control and Nudge + groups, with the Nudge group excluded from this comparison. Given the limitations of our sample size and following Cohen's (1992) criteria for effect size, our study was primarily equipped to detect the most substantial difference between the Nudge+ and Control groups. It was not sufficiently powered to detect more subtle differences between the Control and Nudge groups or between the Nudge and Nudge + groups. Despite this, the trend in our data suggest that the nudge + interventions (comprising the welcome speech and signboard messages) enhanced the impact of the menu design, influencing the participants' choices towards more plant-based options as shown in Fig. 4.

As the participants came out of the lab we distributed a follow-up paper-based questionnaire in which we clarified the concept of nudging and inquired about the participants' awareness, acceptance, and interest in nudging, among other topics. About half of the participants were either fully or partially familiar with the idea of nudging.

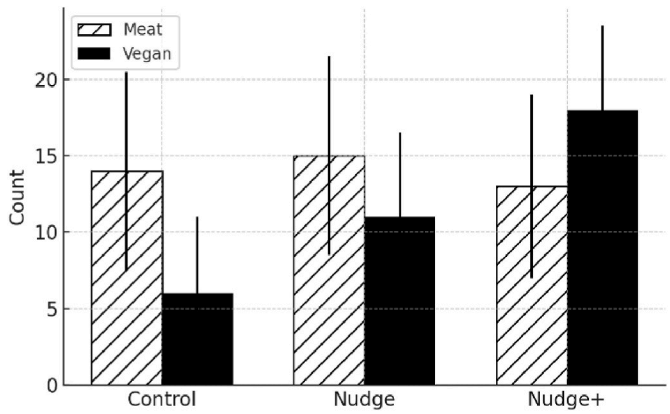

Fig. 4. Food choice according to treatments.

Furthermore, the participants generally viewed nudging as an acceptable method for reducing visitors' climate footprint, with an average rating of 4.2 out of 5 for acceptability (SD = 0.9). They also showed moderate interest in seeing tourism companies use nudging to influence consumer behaviour on their future vacations, with an average interest rating of 3.7 (SD = 0.9). Notably, even those who experienced the Nudge + interventions did not perceive the climate messages as intrusive, scoring an average of 2.5 (SD = 1.6). Overall, these findings support previous indications that low-cost nudging interventions hold promise for encouraging pro-environmental behaviour albeit with limited efficiency.

5. Discussion and conclusion

In this study we examined the potential of a small-scale tourist destination to identify and mitigate its climate footprint via two complementary strategies – ecological modernisation through infrequent decisions; and facilitating consumer behavioural change through frequent actions. By combining LCA and a laboratory-based nudging experiment in our study and using Meadows' (1999) leverage points framework and its subsequent refinements (Chan et al., 2020; Fischer and Riechers, 2019; Loehr and Becken, 2021; Rosengren et al., 2020), these strategies can be situated along a continuum from shallow, incremental adjustments to deeper, transformative interventions. Our choice of leverage points was informed by system mapping (by using the LCA and behavioural-journey analyses, we mapped material and decision flows across the destination's subsystems (energy, infrastructure, visitor movement, purchasing opportunity); sensitivity and feedback analysis (we examined which variables showed the highest sensitivity, where a marginal change (e.g., heating settings, food choice) would cause highest effects on emissions or norms); and depth of the intervention (shallow to deep). For instance, upgrading heating control systems was categorized as a shallow leverage point because it changes technical parameters, while redesigning visitor communications via nudge + acted at an intermediate leverage point by altering information flows and social feedbacks. Based on our analysis we offer the following insights regarding strategies for climate change mitigation among small-scale tourism entrepreneurs and destinations.

5.1. Leverage points for ecological modernisation expose key challenges in tourism-climate nexus

Through holistic assessment of energy consumption at operations it was possible to identify leverage points where energy efficiency can be improved without significant negative impacts on tourist experiences. Through the LCA we observed that the leverage points for climate change mitigation at the zoo, which were under the immediate management control were rather limited to begin with, while the substantial reliance on electrical equipment made the energy consumption the primary climate impact. As the zoo receives its electricity from an external source (the environmental performance of which was outside the scope of this study) the smaller efficiency improvements become harder to implement while the larger investments into independent alternative energy sources are typically beyond the means of smaller entrepreneurs. Possible operational tweaks as, for example, e.g., installing sensor-controlled lighting and heating, correspond to shallow leverage points, i.e. changes to parameters and feedbacks (Meadows, 1999), which can generate incremental gains but rarely shift systemic behaviour (Chan et al., 2020; Gittins et al., 2025).

The seasonal mismatch between visitor numbers and energy use reflects a feedback misalignment and illustrates the challenge of conflicting system goals, i.e. maintaining year-round operations to combat seasonality versus reducing off-season emissions. During the fall, winter, and spring months, the energy demand for heating is particularly high, and the business has to provide 'non-rivalrous' or 'non-excludable' experience to its visitors, where providing the experience for one visitor means providing it for all. This situates the issue at an intermediate leverage point involving the rules and objectives of the system (Fischer and Riechers, 2019). Addressing it could involve redefining destination success metrics away from visitor volume towards resilience and low-carbon performance (Loehr and Becken, 2021).

Counteracting seasonality is one of the oldest imperatives of destination managers, so the fact that the zoo manages to maintain its operations all year round is highly valued by the whole destination. In other words, the goals of keeping the business running and the destination attractive all year round are in conflict with the energy optimisation and climate change mitigation goals. Although tourist numbers at a destination are often directly linked to higher climate impacts it is not always the case when it comes to individual business operations. High levels of seasonality typical to tourism business in general and local climate conditions can mean that all-year-round operations should focus more on improving their energy efficiency in low season rather than in the high season. Further, giving hotel guests better means to control their electricity and heating use during their stay (through nudging or other means) could also contribute to reducing energy consumption.

A critical limitation of the ecological modernisation strategy is that reliance on technological solutions risks reinforcing a blind belief in "win-win" scenarios without confronting underlying limitless growth paradigms (Lidskog and Elander, 2012). Technological optimism is one of the key features of this approach, where technology is viewed as the key to mitigating environmental impacts, which can lead to underestimation of the complexity of pressing issues and overshadow the need for fundamental systemic changes. Without supportive governance, investment in renewable infrastructure, and cross-sector collaboration, i.e. interventions situated at deeper leverage points, the capacity of small-scale operators to meaningfully reduce emissions remains limited (Gittins et al., 2025; Ingram, 2024).

Overall, the LCA revealed that heating systems in visitor-facing facilities represent critical infrequent decision points at the parameter and feedback levels of the system (Meadows, 1999). While large-scale infrastructural transformations, such as renewable energy adoption, often lie beyond the economic reach of small entrepreneurs (Ingram, 2024), targeted efficiency upgrades and seasonally optimized operations can still deliver meaningful emissions reductions. Context-specific energy audits and seasonal analyses emerge as valuable tools for identifying these shallow-to-intermediate leverage points, enabling incremental change while informing broader structural reforms (Loehr and Becken, 2021).

5.2. Leverage points for behavioural change require a holistic analysis of the customer journey and strategic communication

This part of the study contributed to the growing body of behavioural tourism research by empirically testing the application of nudge+ in a tourism context. The results of the study, performed in a controlled lab environment, reinforce the theoretical value of bridging green nudging and transformative experiences through a nudge + approach. While classic nudges may prompt immediate behavioural shifts, and transformative experiences aim to reach deeper values, nudge + offers a hybrid mechanism that engages both reflexive and reflective systems (Richardson and John, 2021). Our findings support earlier suggestions (e.g. Banerjee and John, 2021; Banerjee et al., 2022) that nudge + can positively influence pro-environmental behavioural intentions through the integration of reflective elements into choice architecture without compromising the hedonic quality of tourist experiences.

The nudge + approach operates mainly at information flow and feedback loop leverage points, with potential to influence mindsets when reflective engagement fosters climate-conscious norms (Banerjee and John, 2021; Richardson and John, 2021). This supports the argument made by John and Stoker (2019) that nudge + enhances transparency and individual autonomy, in contrast with the common critique that nudging is manipulative or paternalistic (Sunstein, 2016). By making the intent of the intervention explicit and embedding opportunities for reflection, nudge + appears to increase both legitimacy and participant agency.

Our interpretation of nudge + entails a systemic rethinking of the tourism experiencescape and visitor journey - balancing enjoyment with climate-conscious engagement (Dolnicar, 2020; Juvan and Dolnicar, 2017; Viglia and Dolnicar, 2020). Conscious design of tourst experiencescapes can include touchpoints for embedding reflective elements, particularly moments of non-activity such as walking trails. These 'slow' moments, when tourists are most receptive to environmental messaging, can serve as natural platforms for promoting environmental awareness and fostering cognitive engagement without disrupting enjoyment.

In general, narratives embedded in the destination experience are central to the nudge + design. These narratives should be positive, relevant, and actionable, linking the tourism experience to everyday life. Messaging must be strategically timed to avoid interfering with the core experience. Based on this study, we suggest mapping the entire customer journey to identify slow-paced segments and key touchpoints for delivering such messages, i.e. leverage points. This has important implications for tourism practitioners seeking to integrate sustainability into visitor experiences without diminishing satisfaction.

Small-scale interventions can contribute to norm shifts and social tipping points (Otto et al., 2020) but due to limited scope and duration of our study, conclusions about long-term effects remain tentative. Overall, our laboratory experiment demonstrated that the nudge + approach (Banerjee and John, 2021) has potential to influence sustainable choices without diminishing visitor satisfaction. By embedding such interventions into the visitor journey, destinations can act at the information flow and potentially mindset levels of the system (Chan et al., 2020). Importantly, participant acceptance of nudge + supports prior findings that transparency and agency strengthen the legitimacy of behavioural interventions (John and Stoker, 2019). We therefore encourage further empirical testing through field experiments and longitudinal studies. Ultimately, nudge + may enable tourism actors to reduce environmental impact while enhancing visitor satisfaction and contributing to broader sustainability goals.

5.3. Conclusion

With a novel interdisciplinary approach, using methods rarely applied in tourism studies, we combined life cycle assessment (LCA) and a laboratory experiment to explore strategies with leverage points for climate change mitigation (Meadows, 1999; Fischer and Riechers, 2019; Chan et al., 2020; Rosengren et al., 2020). While this study refers broadly to climate change mitigation, our empirical assessment focused on energy consumption as the primary and most measurable proxy of climate impact at the destination level. Energy use in heating, lighting, and equipment operation represents the main source of greenhouse gas (GHG) emissions for small-scale tourism facilities where direct emission data are unavailable.

Through this interdisciplinary approach, we contribute to three areas of scholarship: (1) advancing the operationalisation of leverage-points thinking in tourism climate research; (2) demonstrating how ecological modernisation and behavioural interventions can jointly inform destination-level mitigation strategies; and (3) illustrating how small-scale, bottom-up actions can complement systemic policy frameworks. In doing so, we offer a context-sensitive understanding of how climate change mitigation in tourism can progress from isolated improvements toward integrated, transformative pathways for low-carbon destination management.

Overall, this study exposes the complexities of climate change mitigation in tourism and reinforces calls in the leverage points literature for a more holistic approach in tourism climate action: combining quick wins at shallow points (e.g., efficiency measures, choice architecture) with more ambitious shifts at deeper points (e.g., redefining destination success metrics, embedding regenerative tourism values). For small-scale destinations, the synergy between bottom-up innovation, strategic communication, and supportive governance frameworks offers a viable pathway toward climate mitigation that is both context-sensitive and systemically informed.

Future research should examine how such integrated models can be scaled and sustained across different destination contexts, ensuring alignment between local actions and higher-level governance, policy incentives, and paradigm shifts toward post-growth, low-carbon tourism futures.

CRediT authorship contribution statement

Lusine Margaryan: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jonathan Yachin:** Writing – original draft, Data curation, Conceptualization. **Joseph Pechsiri:** Writing – original draft, Software, Methodology, Formal analysis, Data curation. **Maria Lexhagen:** Writing – review & editing, Supervision, Resources, Investigation, Funding acquisition, Conceptualization. **Dimitri Ioannides:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

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Data availability

Data will be made available on request.

References

Abson, D.J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., von Wehrden, H., Abernethy, P., Ives, C.D., Jager, N.W., Lang, D.J., 2017. Leverage points for sustainability transformation. Ambio 46 (1), 30–39. https://doi.org/10.1007/s13280-016-0800-y.

Banerjee, S., John, P., 2021. Nudge plus: incorporating reflection into behavioral public policy. Behav. Public Pol. 1–16.

Banerjee, S., Galizzi, M.M., John, P., Mourato, S., 2022. What Works Best in Promoting Climate Citizenship? A Randomised, Systematic Evaluation of Nudge, Think, Boost

and Nudge+. A Randomised, Systematic Evaluation of Nudge, Think, Boost and Nudge+ (April 26, 2022). Research Square pre-prints.
Capoccia, G., Kelemen, R.D., 2007. The study of critical junctures: theory, narrative, and counterfactuals in historical institutionalism. World Polit. 59 (3), 341–369.
Carlsson, F., Gravert, C., Johansson-Stenman, O., Kurz, V., 2021. The use of green nudges as an environmental policy instrument. Rev. Environ. Econ. Pol. 15 (2), 216–237. https://doi.org/10.1086/715524.
Chan, K.M., Boyd, D.R., Gould, R.K., Jetzkowitz, J., Liu, J., Muraca, B., et al., 2020. Levers and leverage points for pathways to sustainability. People Nat. 2 (3), 693–717.
Chen, W.Y., Suzuki, T., Lackner, M. (Eds.), 2017. Handbook of Climate Change Mitigation and Adaptation. Springer International Publishing, Cham, Switzerland.
De Camillis, C., Raggi, A., Petti, L., 2010. Tourism LCA: state-of-the-art and perspectives. Int. J. Life Cycle Assess. 15, 148–155.
Dhir, A., Talwar, S., Kaur, P., Malibari, A., 2020. Food waste in hospitality and food services: a systematic literature review and framework development approach. J. Clean. Prod. 270, 122861.
Dolnicar, S., 2020. Designing for more environmentally friendly tourism. Ann. Tourism Res. 84, 102933.
Filimonau, V., 2016. Life Cycle Assessment (LCA) and Life Cycle Analysis in Tourism. Springer, Berlin/Heidelberg, Germany.
Filimonau, V., Lemmer, C., Marshall, D., Bejjani, G., 2017. 'Nudging' as an architect of more responsible consumer choice in food service provision: the role of restaurant menu design. J. Clean. Prod. 144, 161–170.
Fischer, J., Riechers, M., 2019. A leverage points perspective on sustainability. People Nat. 1 (1), 115–120.
Frischknecht, R., Jungbluth, N., Althaus, H.-J., Hischier, R., Doka, G., Bauer, C., Dones, R., Nemecek, T., Hellweg, S., Humbert, S., 2007. *Implementation of Life Cycle Impact Assessment Methods. Data v2. 0.* Ecoinvent Report No. 3. Ecoinvent Centre.
Ghosh, A., Kayal, P., Bagchi, P., 2024. Climate change and tourism: assessing the nexus and climate-related disasters in diverse economies. J. Clean. Prod. 443, 141097.
Gittins, J.R., Picken, J., Dajka, J.C., 2025. A Leverage Points Framework To Manage Changes in River Health. River Research and Applications 41 (1), 177–189.
Gladwell, M., 2006. The Tipping Point: How Little Things can Make a Big Difference. Little, Brown.
Gössling, S., Balas, M., Mayer, M., Sun, Y.Y., 2023. A review of tourism and climate change mitigation: the scales, scopes, stakeholders and strategies of carbon management. Tour. Manag. 95, 104681.
Gössling, S., Humpe, A., Sun, Y.Y., 2024. On track to net-zero? Large tourism enterprises and climate change. Tour. Manag. 100, 104842.
Herrero, C.C., Laso, J., Cristóbal, J., Fullana-i-Palmer, P., Albertí, J., Fullana, M., et al., 2022. Tourism under a life cycle thinking approach: a review of perspectives and new challenges for the tourism sector in the last decades. Sci. Total Environ. 845, 157261.
Higham, J., Cohen, S.A., Cavaliere, C.T., Reis, A., Finkler, W., 2016. Climate change, tourist air travel and radical emissions reduction. J. Clean. Prod. 111, 336–347.
Hunter, H., 2024. The transtheoretical model of behavior change: implications for social work practice. J. Hum. Behav. Soc. Environ. 34 (2), 300–314.
Ingram, R., 2024. Using leverage points to reconsider the sociopolitical drivers of exclusion from education. Educational Philosophy and Theory 56 (11), 1077–1087.
Intergovernmental Panel on Climate Change (2023), 2023. Summary for policymakers. Clim. Change 2023: Synthesis Rep. Available https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf. (Accessed 1 January 2022).
John, P., Stoker, G., 2019. Rethinking the role of experts and expertise in behavioural public policy. Pol. Polit. 47 (2), 209–225. https://doi.org/10.1332/030557319X15526371698257.
Jänicke, M., 2008. Ecological modernisation: new perspectives. J. Clean. Prod. 16 (5), 557–565.
Jänicke, M., 2020. On ecological and political modernization. In: The Ecological Modernisation Reader. Routledge, pp. 28–41.
Juvan, E., Dolnicar, S., 2017. Drivers of pro-environmental tourist behaviours are not universal. J. Clean. Prod. 166, 879–890.
Lawson, P.J., Flocke, S.A., 2009. Teachable moments for health behavior change: a concept analysis. Patient Educ. Counsel. 76 (1), 25–30.
Lehner, M., Mont, O., Heiskanen, E., 2016. Nudging–A promising tool for sustainable consumption behaviour? J. Clean. Prod. 134, 166–177.
Lenzen, M., Sun, Y.Y., Faturay, F., Ting, Y.P., Geschke, A., Malik, A., 2018. The carbon footprint of global tourism. Nat. Clim. Change 8 (6), 522–528.
Lidskog, R., Elander, I., 2012. Ecological modernization in practice? The case of sustainable development in Sweden. J. Environ. Pol. Plann. 14 (4), 411–427.
Loehr, J., Becken, S., 2021. Leverage points to address climate change risk in destinations. Tour. Geogr. 25 (2–3), 820–842.
Margaryan, L., Stensland, S., 2017. Sustainable by nature? The case of (non) adoption of eco-certification among the nature-based tourism companies in Scandinavia. J. Clean. Prod. 162, 559–567.
Meadows, D., 1999. Leverage points. Places to intervene in a System. Sustain. Institute.
Nowak, M., 2025. Pro-Sustainable Consumer Behaviour in Tourism and Hospitality: Drivers, Barriers, and Effective Behavioural Intervention Design. Mid Sweden University. Doctoral dissertation.
Nowak, M., Alnyme, O., Heldt, T., 2023. Testing the effectiveness of increased frequency of norm-nudges in encouraging sustainable tourist behaviour: a field experiment using actual and self-reported behavioural data. J. Sustain. Tourism 1–25.
Otto, I.M., Donges, J.F., Cremades, R., Bhowmik, A., Hewitt, R.J., Lucht, W., Rockström, J., Allerberger, F., McCaffrey, M., Doe, S.S., Lenferna, A., 2020. Social tipping dynamics for stabilizing Earth's climate by 2050. Proceedings of the National Academy of Sciences 117 (5), 2354–2365.
Pett, J., 2009. "What if it's a big hoax and we create a better world for nothing?" [Editorial cartoon]. USA Today.
Poore, J., Nemecek, T., 2018. Reducing food's environmental impacts through producers and consumers. Science 360 (6392), 987–992. https://doi.org/10.1126/science.aaq0216.
Reisch, L.A., Sunstein, C.R., Andor, M.A., Doebbe, F.C., Meier, J., Haddaway, N.R., 2021. Mitigating climate change via food consumption and food waste: a systematic map of behavioral interventions. J. Clean. Prod. 279, 123717.
Richardson, L., John, P., 2021. Co-designing behavioural public policy: lessons from the field about how to 'nudge plus'. Evidence & Policy 17 (3), 405–422.
Riechers, M., Loos, J., Balázsi, Á., García-Llorente, M., Bieling, C., Burgos-Ayala, A., et al., 2021. Key advantages of the leverage points perspective to shape human-nature relations. Ecosyst. People 17 (1), 205–214.
Rosengren, L.M., Raymond, C.M., Sell, M., Vihinen, H., 2020. Identifying leverage points for strengthening adaptive capacity to climate change. Ecosyst. People 16 (1), 427–444.
Schubert, C., 2017. Green nudges: do they work? Are they ethical? Ecol. Econ. 132, 329–342. https://doi.org/10.1016/j.ecolecon.2016.11.009.
Scott, D., Gössling, S., 2022. A review of research into tourism and climate change-launching the annals of tourism research curated collection on tourism and climate change. Ann. Tourism Res. 95, 103409.
Souza-Neto, V., Marques, O., Mayer, V.F., Lohmann, G., 2023. Lowering the harm of tourist activities: a systematic literature review on nudges. J. Sustain. Tourism 31 (9), 2173–2194. https://doi.org/10.1080/09669582.2022.2036170.
Sunstein, C.R., 2016. *People prefer system 2 nudges* (kind of). Duke LJ 66, 121.
Thaler, R.H., Sunstein, C.R., 2008. Nudge: Improving Decisions About Health, Wealth, and Happiness. Yale University Press.
Viglia, G., Dolnicar, S., 2020. A review of experiments in tourism and hospitality. Ann. Tourism Res. 80, 102858.
Yachin, J.M., 2020. Behind the Scenes of Rural Tourism: a Study of Entrepreneurship in Micro-firms. Mid Sweden University. Doctoral dissertation.